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09/632,425	08/04/2000	Fabrice Geiger	A3024/T28300	1892

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Patent Counsel M/S 2061
Legal Affairs Department
Applied Materials Inc
P O Box 450A
Santa Clara, CA 95052

EXAMINER

KILDAY, LISA A

ART UNIT PAPER NUMBER

2829

DATE MAILED: 07/24/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/632,425

Applicant(s)

GEIGER ET AL.

Examiner

Lisa A Kilday

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on amendment filed on 5/17/02.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-19 is/are pending in the application.
- 4a) Of the above claim(s) 20 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-19 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

Response to Arguments

Applicant's arguments with respect to claims 1-19 have been considered but are moot in view of the new ground(s) of rejection.

Claim Objections

Claim 19 is objected to because of the following informalities: "said porous silicon oxide layer" lacks antecedent basis. Appropriate correction is required.

Specification

The disclosure is objected to because of the following informalities: remove footnote on pg. 17.

Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-2, 4-6, 9 are rejected under 35 U.S.C. 102(b) as being anticipated by Cho (5,804,509).

In re claim 1, Cho discloses a method for forming an insulation layer over a substrate, the method comprising: forming a surface sensitive silicon oxide layer (3) over the substrate (1); and forming a porous Silicon oxide layer (4) on the Surface sensitive silicon oxide layer (fig. 1) by thermal chemical vapor deposition, wherein said

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porous silicon oxide layer is deposited at a temperature of about 400C or less (col. 2 lines 50-60).

In re claim 2, Cho discloses the method of claim 1 wherein the porous silicon oxide layer has a carbon content of at least 5 atomic percent. It is inherent that an insulating film formed by a carbon containing silane, Tetraethylorthoxisilicate gas (TEOS), contains a carbon content of at least 5 atomic %.

In re claim 4, Cho discloses the method of claim 1 wherein the surface sensitive silicon oxide layer is deposited from a plasma enhanced CVD reaction of TEOS and oxygen (col. 3 lines 53-60).

In re claim 5, Cho discloses the method of claim 1 wherein the porous silicon oxide layer is deposited from a process gas comprising TEOS and ozone (col. 3 lines 53-60).

In re claim 6, Cho discloses the method of claim 5 wherein a molar ratio of said TEOS to ozone is between about 10:1 and 20:1 (col. 3 lines 7-15).

In re claim 9, Cho discloses the method of claim 1 wherein said surface sensitive and porous silicon oxide layers are deposited in an in situ process (abstract lines 9-13).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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Claims 3, 7-8, 10-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cho as applied to claim 1 above, and in view of Lan (6,180,507).

In re claim 3, Cho discloses forming a surface sensitive silicon oxide layer over the substrate and a porous silicon oxide layer on the surface of the sensitive silicon oxide layer. However, Cho does not teach that the porous silicon oxide layer has a dielectric constant of between about 2.9 and 3.2. However, Lan teaches that the dielectric constant of porous silicon oxide layers are (208) between the dielectric constant of air 1.00059 and lower than the dielectric constant of a conventional silicon oxide layer, 4.0 (col. 3 lines 8-15). Therefore, it would be obvious to one skilled in the art to form a porous silicon oxide layer with a dielectric constant of between 2.9 and 3.2 because air in the holes of the porous silicon oxide layer reduce the dielectric constant in order to reduce RC delay.

Claim 7 adds the limitation of forming a capping silicon oxide layer over the porous silicon oxide layer. Cho does not teach forming a capping layer over the porous silicon oxide layer. However, Lan teaches forming a capping layer (214) over the porous silicon oxide layer (208). Therefore, it would be obvious to one skilled in the art to form a capping layer over the porous silicon oxide layer because in order to protect the porous silicon oxide during planarization.

In re claim 8, Cho discloses the process of claim 1 wherein said porous silicon oxide layer is deposited. However, Cho does not teach using an SACVD process at a pressure of between 100-700 Torr. However, Lan teaches forming a porous silicon oxide layer (212) using TEOS and ozone at a pressure of 100-700 Torr (col. 2 lines 56-

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61). Therefore, it would be obvious to one skilled in the art to deposit porous silicon oxide layer at sub-atmospheric pressure in order for uniform and controlled deposition.

In re claim 10, Cho teaches a method for depositing an intermetal dielectric film over a plurality of conductive lines (2), the method comprising: depositing a plasma enhanced chemical vapor deposition (CVD) silicon oxide layer over the plurality of conductive lines from a plasma of tetraethyloxysilane (TEOS) and oxygen; and depositing a silicon oxide layer over the plasma enhanced CVD silicon oxide layer by a thermal CVD process from a gas mixture of a TEOS and ozone. However, Cho does not teach that said thermal silicon oxide layer has a dielectric constant of about 3.2 or less. It is inherent that an insulating film formed by a carbon containing silane, Tetraethylorthoxisilicate gas (TEOS), contains a carbon content of at least 5 atomic %. However, Lan teaches that the dielectric constant of porous silicon oxide layers (208) are between the dielectric constant of air 1.00059 and lower than the dielectric constant of a conventional silicon oxide layer, 4.0 (col. 3 lines 8-15). Therefore, it would be obvious to one skilled in the art to form a porous silicon oxide layer with a dielectric constant of between 2.9 and 3.2 because air in the holes of the porous silicon oxide layer reduce the dielectric constant in order to reduce RC delay.

Claim 11 adds the limitation of wherein the density of said thermal silicon oxide layer is less than or equal to about 1.7 g/cm³. Cho teaches that the density of the thermal silicon oxide layer is less than or equal to about 1.7 g/cm³ (col. 5 lines 21-25).

Claim 12 adds the limitation of forming a PECVD silicon oxide layer capping over the thermal silicon oxide layer. Cho does not teach forming a capping layer over the

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thermal silicon oxide layer. However, Lan teaches forming a PECVD capping layer (214) over the thermal silicon oxide layer (208). Therefore, it would be obvious to one skilled in the art to form a PECVD capping layer over the thermal silicon oxide layer because the PECVD capping layer protects the thermal silicon oxide layer.

In re claim 13, Cho teaches forming a thermal silicon oxide layer. However, Cho does not teach that the dielectric constant of said thermal silicon oxide layer is greater than or equal to about 2.9. However, Lan teaches that the dielectric constant of porous silicon oxide layers are (208) between the dielectric constant of air 1.00059 and lower than the dielectric constant of a conventional silicon oxide layer, 4.0 (col. 3 lines 8-15). Therefore, it would be obvious to one skilled in the art to form a porous silicon oxide layer with a dielectric constant that is greater than or equal to about 2.9 and 3.2 because air in the holes of the porous silicon oxide layer reduce the dielectric

Claims 14-16 adds the limitation of wherein a molar ratio of said TEOS and ozone used to deposit said thermal silicon oxide layer is at least 8:1. Cho teaches that a molar ratio of said TEOS and ozone used to deposit said thermal silicon oxide layer is at least 8:1 (col. 3 lines 7-15) and in the range of 10:1-20:1. However Cho does not teach the limitation of claim 10, wherein the thermal silicon oxide layer has a dielectric constant of about 3.2 or less. Lan teaches depositing a thermal oxide layer with TEOS and ozone with a dielectric constant that is lower than the conventional silicon oxide layer. It would be obvious to one skilled in the art to deposit a thermal silicon oxide layer with a molar ratio of TEOS to O₃ that is greater than 8:1 but in the range of 10:1 and 20:1 as a matter of routine optimization.

Claim 17 adds the limitation of wherein said oxygen is provided from a flow of molecular oxygen. Cho does not teach providing a molecular oxygen source. However, Lan teaches forming a thermal CVD layer using a molecular oxygen source as a source of oxygen (col. 2 lines 56-60). It is well known in the art to use molecular oxygen as the source of oxygen. Therefore, it would be obvious to one skilled in the art to deposit a thermal silicon oxide layer using molecular oxygen as a source for oxygen in addition to TEOS or ozone because molecular oxygen is an inexpensive source of oxygen and well-known substitute for O₃ or TEOS.

Claim 18 adds the limitation of wherein said plasma enhanced and thermal CVD silicon oxide layers are deposited in an in situ process. Cho does not teach forming a low dielectric constant layer. However Cho does teach forming PECVD and thermal CVD silicon oxide layers in situ (abstract lines 9-13). However Lan teaches forming PECVD and thermal CVD layers that have a low dielectric constant layer. It is well known in the art to form silicon oxide layers in situ. Therefore, it would be obvious to one skilled in the art to form PECVD and thermal silicon oxide layers in situ as taught by Cho in order to reduce the dielectric constant as taught by Lan.

In re claim 19, Cho discloses the process of claim 10 wherein said porous silicon oxide layer is deposited. However, Cho does not teach using an SACVD process at a pressure of between 100-700 Torr. However, Lan teaches forming a porous silicon oxide layer (212) using TEOS and ozone at a pressure of 100-700 Torr (col. 2 lines 56-61). Therefore, it would be obvious to one skilled in the art to deposit porous silicon oxide layer at sub-atmospheric pressure in order for uniform and controlled deposition.

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Conclusion

Any inquiry of a general nature or relating to the status of this application should be directed to the Group Receptionist whose telephone number is (703) 308-0957. See MPEP 203.08.

Any inquiry concerning this communication from the examiner should be directed to Lisa Kilday whose telephone number is (703) 306-5728. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Sherry, can be reached on (703) 308-1680. The fax number for the group is (703) 305-3432. MPEP 502.01 contains instructions regarding procedures used in submitting responses by facsimile transmission.

Lisa Kilday

LAK

7/19/02

A handwritten signature in cursive script, appearing to read "Michael Sherry", with the date "7/19/02" written below it.

**MICHAEL SHERRY
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800**